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New Records of Hypotrichs from Korea (Protozoa, Ciliophora, Hypotrichida)

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한국산 미기록 하모충류의 재기재 (原生動物, 有毛門, 下毛目)

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적 요

서울의 한강과 관악산 계류에서 채집하여 실험실에서 배양한 하모섬모충류가 한국 미기록 종인 *Paruroleptus lepisma* Wenzel, 1953과 *Euplotes aediculatus* Pierson, 1943으로 밝혀져 형태 및 통계처리에 관한 연구를 실시했다. 서식처에서 채집한 표본과 실험실에서 배양한 것을 각각 생체 관찰하고 protargol로 염색하여 섬모하부구조를 관찰하고 통계처리를 하였으며 재기재 하였다.

Key words: Protozoa, Hypotrichida, infraciliature, biometry, Korea.

INTRODUCTION

The saprobic waters and soils usually contain diverse assemblage of ciliates. The hypotrichous ciliates are one of the most conspicuous groups among them (Borror, 1972; Foissner, 1980, 1982; Shin and Kim, 1988; Berger and Foissner, 1989). However, because of their delicate morphology and small size, the biology of these ciliates has little become known to us. In the present paper, we focus on its general morphology, especially infraciliature, of both wild and cultured cells.

MATERIALS AND METHODS

The materials were collected from the saprobic waters of the Han River (37° 32′ N, 127° 02′ E) on September 17, 1991 and the moist soils and litters of the Mountain Kwanak (37° 26′ N, 126° 56′ E) in Seoul on June 6, 1992. Several individuals were cultured in Petri dishes containing natural water or mineral water with shrimp meats and boiled wheat grains (Song, 1991). Some cells were maintained in the different dishes with unknown small ciliates and flagellates.

The body shapes of the living specimens on slides were drawn without cover slips. The infraciliature was observed with the protargol and wet silver impregnation method (Wilbert, 1975; Foissner, 1992; Lynn, 1992). To demonstrate the micronucleus, the Feulgen technique was used. The drawings of the impregnated specimens were made with a camera lucida. All counts and measurements were carried out under the compound microscope at the magnifications of X400 - X1600 and were analyzed biometrically using Sigma Plot PC package, Jandel Co. The terminology is according to Borror (1972), Curds (1975), Foissner (1982), Hemberger (1982), and Corliss and Lom (1985). The classification scheme used is according to Corliss (1979).

The abbreviations in the table are as follows: AM: adoral membranelles; AZM: adoral zone of membranelles; BC: buccal cirrus; CC: caudal cirri; CV: coefficient of variation; DK: dorsal kinety; FC: frontal cirri; FTC: frontoterminal cirri; FVC: frontoventral cirri; LMC: left marginal cirri; LMVC: left mid-ventral cirri; Ma: macronucleus; Max: maximum; Min: minimum; n: size of individuals examined; RMC: right marginal cirri; RMVC: right mid-ventral cirri; SD: standard deviation; SE: standard error of the mean; TC: transverse cirri; UM: undulating membrane; x: arithmetic mean.

SYSTEMATIC ACCOUNT

Phylum Ciliophora Doflein, 1901
Class Polyhymenophora Jankowski, 1967
Order Hypotrichida Stein, 1859
Family Holostichidae Faurè-Fremiet, 1961
Genus *Paruroleptus* Kahl, 1932

Paruroleptus lepisma Wenzel, 1953 (Fig.1, Table 1)

Paruroleptus lepisma Wenzel, 1953 (pp.109-111, figs. 22a-b); Berger & Foissner, 1989 (pp.23-24, figs. 9-5, tabs. 1,3)

Material examined: 20 wild living specimens were collected from the moist soils and litters in the valley of the Kwanak Mt., Seoul, Korea, on June 6, 1992 and were cultured in laboratory. Eight protargol impregnated specimens were analyzed biometrically and the data were summarized in Table 1.

Description: Body flexible, contractile, elongate, slender, slightly flattened dorso-ventrally, and conspicuously tapering posteriorly like a tail, 142-195 x 62-92 μm *in vivo*; anterior end rounded; central part widened; posterior tip somewhat dilated and bent or curved toward right-hand side; dorsal surface convex. Movement slow to rapid.

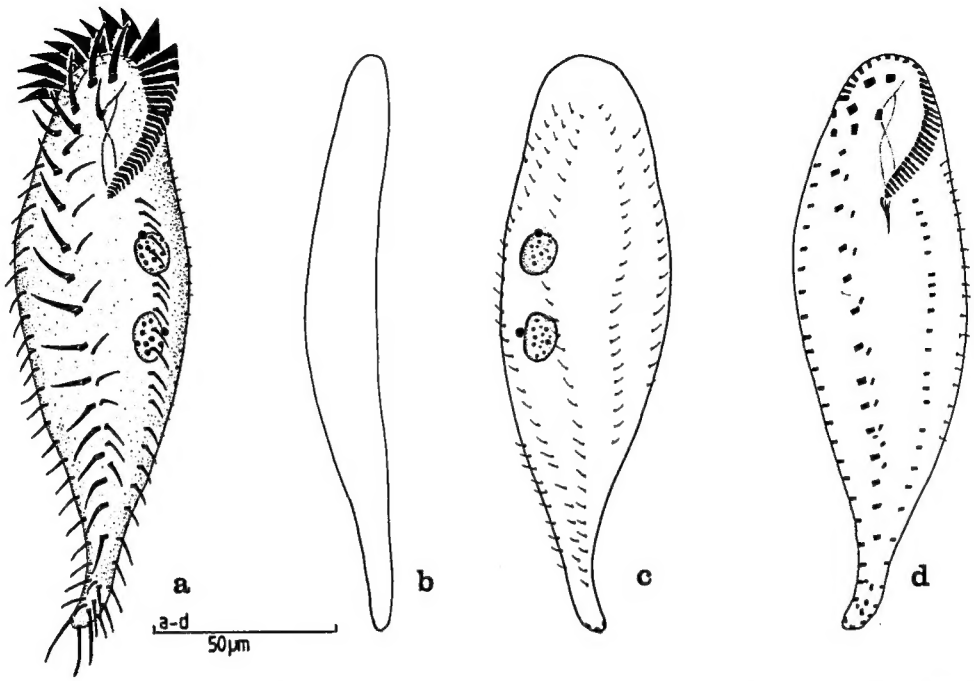

Fig. 1. *Paruroleptus lepisma* Wenzel: a, living specimen, ventral view; b, same, lateral view; c, infraciliature after protargol impregnation, dorsal view; d, same, ventral view.

Frontal and buccal fields consisting of 3 prominent frontal, 2 frontoterminal and 1 buccal cirri; Adoral zone of membranelles 40 - 48 μm, covering approximately 28% of body length, with prominent 25-36 membranelles. Buccal field deep, comprising endoral membrane and undulating membrane, length 30-40 μm. Pharyngeal fibrils at base of buccal field extending posteriorly.

Somatic infraciliature consisting of 2 rows of midventral cirri, each row having 13-15 cirri, respectively, extending across diagonally from anterior to posterior; size of left midventral cirri distinctly smaller than those of right ones; posterior tail region consisting of 4 transverse, 1 remote ventral cirrus near transverse cirri and 4 caudal cirri. Both marginal cirri extending almost to posterior end; distance between marginal cirri increasing in posterior direction; right marginal cirri beginning at more anterior region than left ones; right marginal beginning at region beneath 2nd frontoterminal cirrus and left ones beginning at region beneath 5-7th adoral membranelles. Dorsal surface having typically 5 kineties, of them, mid-dorsal kinety with 24-28 cilia; cilia on dorsal surface bristle-like, approximately 5 μm long, some of them more or less shortened.

Nuclear organelles consisting of 2 elliptical macronuclei, 12-18 × 8-11 μm, lying slightly left of median of body; 2-3 micronuclei spherical, 3 × 3 μm.

Contractile vacuole located close behind adoral zone of membranelles, with posterior channel in resting period.

Remarks: The present specimens well accorded with the original description of Wenzel (1953) and redescription of Berger and Foissner (1989) except body size and the number of marginal cirri. The present species is very similar to *Paruroleptus caudatus* (Stokes, 1886), but distinguishable from the latter in several respects. First of all, in the body size and the proportions of body length to width, the latter is more large and slender than the former. Second, the number of transverse cirri of the former is four, while the latter

Table 1. Biometrical characterization of *Paruroleptus lepisma* Wenzel. All data were based on protargol-impregnated individuals.

Character	x	SD	SE	CV	Max	Min	n
Body length (μm)	159.3	20.8	7.8	13.0	195	142	7
Body width (μm)	69.0	12.0	4.5	17.3	92	57	7
AM, number	31.1	3.6	1.3	11.5	36	25	7
AZM,length (μm)	44.2	2.9	1.1	6.5	48	40	7
Ma segments, number	2.0	0.0	0.0	0.0	2	2	7
Ma,length (μm)	14.7	2.1	0.8	14.2	18	12	7
Ma, width (μm)	9.0	1.1	0.4	12.2	11	8	7
Mi segments, number	2.1	0.3	0.1	14.2	3	2	7
Mi, length (μm)	3.0	0.0	0.0	0.0	3	3	7
Mi, width (μm)	3.0	0.0	0.0	0.0	3	3	7
UM, length (μm)	33.8	3.3	1.2	9.7	40	30	7
BC, number	1.0	0.0	0.0	0.0	1	1	7
FC, number	3.0	0.0	0.0	0.0	1	1	7
FTC, number	2.0	0.0	0.0	0.0	2	2	7
VC near TC, number	1.0	0.0	0.0	0.0	1	1	7
LMVC, number	13.7	0.7	0.2	5.1	15	13	7
RMVC, number	14.2	0.4	0.1	2.8	15	14	7
TC, number	3.8	0.3	0.1	7.8	4	3	7
CC, number	3.7	0.7	0.2	18.9	5	3	7
DK, number	4.9	0.1	0.1	2.0	5	4.5	7
Cilia in DK, number	24.5	4.4	2.2	17.9	28	18	4
Cilia in DK, length (μm)	3.5	1.1	0.4	31.4	5	2	8
LMC, number	21.8	1.8	0.7	8.2	23	18	7
RMC, number	21.1	2.1	0.7	9.9	23	17	7

is five. Third, the habitat of the former is terrestrials, while the latter marshes.

Borror (1972) and Hemberger (1982) treated the genus *Paruroleptus* as a synonym of *Uroleptus*, but recently Grolière (1975), Foissner (1980), Dragesco *et al.*(1986), Berger and Foissner (1989) and Foissner *et al.*(1991) conserved this genus as independent one.

The evaluation of biometrical data showed coefficients of variation (CV) between 0.0 and 2.0 for the number or the length of macronuclear segments, micronucleus length and width, buccal cirri, frontal cirri, frontoterminal cirri, ventral cirrus near transverse cirri and dorsal kineties. Thus these characters are found to be largely constant and therefore of great importance as the diagnostic features of the species. Comparatively low coefficients of variation between 2.8 and 11.5 were calculated for the following characters : number of adoral membranelles, length of adoral zone of membranelles, length of undulating membrane, number of cirri in left and right midventral row, number of transverse cirri and number of cirri in left and right marginal row. These characters also are very important for taxonomy, because of their low variability. Other characters showed fairly high coefficients of variation between 12.2 and 31.4 (Table 1).

Family Euplotidae Ehrenberg, 1838

Genus *Euplotes* Ehrenberg, 1831

Euplotes aediculatus Pierson, 1943 (Fig. 2, Table 2)

Euplotes aediculatus Pierson, 1943 (pp. 138-140, figs. 13, 19-20); Curds, 1975 (pp.17-18, figs. 9-10); Dragesco *et al.*, 1986 (pp. 502-503, figs. 149i-m); Foissner *et al.*, 1991 (pp. 352-356, figs.1-29)

Material examined: 15 wild living specimens were collected from the Han River in Seoul, Korea on September 17, 1991 and these were cultured. 8-16 protargol impregnated specimens were analyzed biometrically and their data were summarized in Table 2.

Description: Body inflexible 122-162×71-120 μm *in vivo*, broadly elliptical or oval in shape; ventral surface flat with 6 weak ridges and fibrils extending across from near transverse cirri to right anterior corner. Dorsal surface convex, slightly ridged and having typically 8 kineties, of them, mid-dorsal kinety with 19-23 cilia. Cilia on dorsal surface bristle-like, approximately 10 μm long, some of them more or less shortened. Dorsal silverline double-eurystomus type (Fig. 2c). Pellicle inflexible.

Somatic infraciliature consisting of 9 frontoventral, 5 transverse and 4 caudal cirri. Cirral pattern of ventral surface rather constant.

Adoral zone of membranelles 90-111 μm, covering 60-70% of body length, with 46-52 membranelles, straight to curved but not sigmoidal shape, and its collar not prominent. Peristome triangular with 2 depressions in median border and its posterior border somewhat crescent-shaped. Diagonal line across buccal field depressed in middle part, forming convex folds. Undulating membrane located innermost part of peristome and 18-31 μm long.

Table 2. Biometrical characterization of *Euplotes aediculatus* Pierson. All data were based on protargol-impregnated individuals.

Character	×	SD	SE	CV	Max	Min	n
Body length (μm)	141.2	15.8	3.9	11.1	162	121	16
Body width (μm)	96.0	13.0	3.2	13.5	120	71	16
AM, number	49.3	2.6	0.9	5.2	52	46	8
AZM, length (μm)	99.5	7.5	2.6	7.5	111	89	8
Ma segments, number	1.0	0.0	0.0	0.0	1	1	8
Mi segments, number	1.0	0.0	0.0	0.0	1	1	8
Mi, length (μm)	6.0	1.1	0.4	18.3	7	4	8
Mi, width (μm)	4.3	1.0	0.3	23.2	6	3	8
UM, length (μm)	21.6	4.5	1.5	20.8	31	18	8
FVC, number	9.0	0.0	0.0	0.0	9	9	8
TC, number	5.0	0.0	0.0	0.0	5	5	8
CC, number	4.0	0.0	0.0	0.0	4	4	8
DK, number	7.7	0.8	0.2	0.3	9	7	9
Cilia in mid-DK, number	21.2	1.5	0.5	7.0	23	19	9

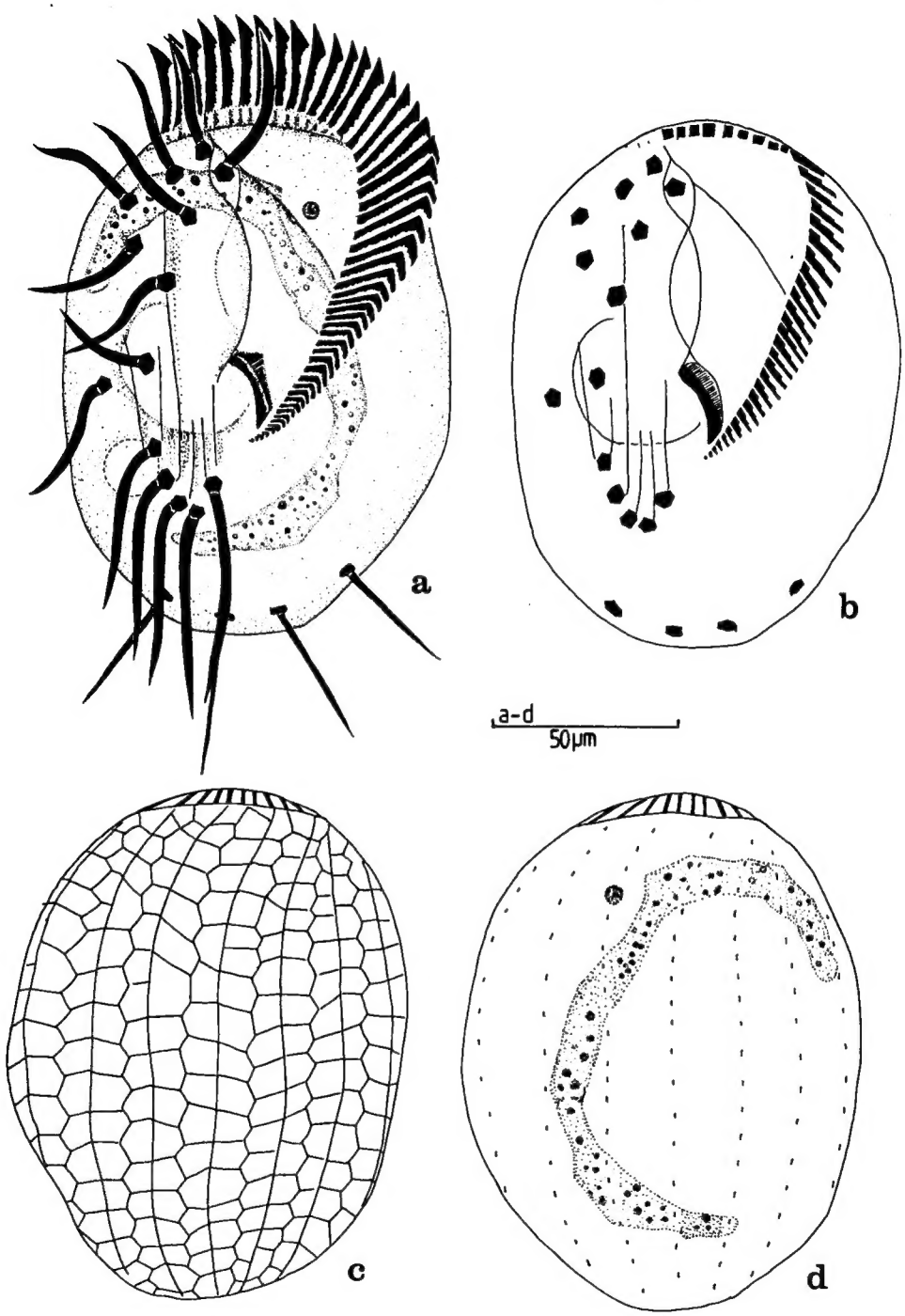

Fig. 2. *Euplotes aediculatus* Pierson : a, entire ventral view of living specimen; b, infraciliature in ventral view after protargol impregnation; c, dorsal silver line after wet silver impregnation; d, dorsal kineties and nuclear arrangement after protargol and wet silver impregnation.

Macronucleus "C"-shaped, arched or flat-backed including "3"- shaped variation. Micronucleus distinctly separated from macronucleus in anterior left part of body, round shape, size 4-7 x 3-6 μm. Contractile vacuole situated to midway between left of second transverse cirrus and right side of body.

Remarks: This species is most closely related to *Euplotes eurystomus* but differs from the latter in several respects. First, the former possesses straight or curved adoral zone of membranelles but the latter with sigmoidal one. Second, the former possesses arched or flat-backed C-shaped macronucleus with distinctly separated micronucleus, but the latter bearing "3"-shaped macronucleus with micronucleus within a cleft of it. Third, the former possesses long and triangular peristomal plate, but the latter with rectangular type. Finally the former possesses two peristomal pouches and eight dorsal kineties but the latter with one and 10, respectively.

The evaluation of biometrical data showed coefficients of variation (CV) between 0.0 and 0.3 for the number of macronuclear and mironuclear segments, frontoventral cirri, transverse cirri and dorsal kineties. Thus these characters of the present species are turned out to be largely constant and consequently, of great importance as the diagnostic characters. Comparatively low coefficients of variation between 5.2 and 13.5 were calculated for the following characters : body length and width, number of adoral membranelles, length of adoral zone of membranelles, micronucleus length and width, length of undulating membrane and number of cilia in mid-dorsal kineties. These characters also are very important for taxonomy, because of their low variability. Other characters showed fairly high coefficients of variation between 18.3 and 23.2 (Table 2).

ABSTRACT

Some hypotrichous ciliates collected from the Han River and the Mountain Kwanak were cultured at laboratory. They were identified as *Paruroleptus lepisma* Wenzel, 1953 and *Euplotes aediculatus* Pierson, 1943. These two species are reported for the first time from Korea. Morphological and biometrical studies of them were carried out by observing both wild and cultured cells and the infraciliature of silver stained specimens. The two species were redescribed and analyzed biometrically for their taxonomic characters.

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